CLAIMS

Claims

[Claim 1] A photonic waveguide comprising of:

a substrate,

a first layer of a nanomaterial,

a second layer of a nanomaterial,

a third layer of the first nanomaterial,

a fourth layer of an optical material,

wherein the second layer has a higher refractive index than the first layer,

wherein the third layer has the same refractive index as the first layer,

wherein the first layer is the bottom cladding,

wherein the second layer is the guiding layer,

wherein the third layer is the top cladding,

wherein the fourth layer is a cover layer,

wherein the second layer is patterned to form the core of the waveguide,

wherein the first and the third layers enclose the second layer, thus forming a waveguide,

wherein the waveguiding is accomplished by the natural index contrast (NIC) principle where the NIC value is given by

$$\Delta n = \frac{n_2 - n_1}{n_1} \times 100 .$$

[Claim 2] The waveguide of claim 1 wherein the waveguide can transmit light at least in the wavelength range of 1060 to 1650 nm.

[Claim 3] The waveguide of claim 1 wherein the first layer comprises of a nanomaterial that is deposited on the said substrate by at least one method from spin-coating, spray deposition, chemical vapor deposition, etc.

[Claim 4] The waveguide of claim 1 wherein the second layer comprises of a nanomaterial that is deposited on top of the said first layer of Claim 3 by at least one method from spin-coating, spray deposition, chemical vapor deposition, etc.

[Claim 5] The waveguide of claim 1 wherein the first layer is at least a dendrimer, a spin-on-glass, a nanosilica, a polymer, and a composition thereof.

[Claim 6] The waveguide of claim 1 wherein the second layer is a dendrimer, a spin-on-glass, nanosilica, a polymer, and a composition thereof.

[Claim 7] The waveguide of claim 1 wherein the thickness of the first layer is controlled at least by solution concentration, solution viscosity, solution pH, spin-coating parameters, and curing parameters.

[Claim 8] The waveguide of claim 1 wherein the thickness of the second layer is controlled at least by solution concentration, solution viscosity, solution pH, spin-coating parameters, and curing parameters.

[Claim 9] The waveguide of claim 1 wherein the patterned second layer comprises of a plurality of waveguides.

[Claim 10] The waveguide of claim 1 wherein the second layer is comprised of at least one waveguide structure from a group of waveguide structures comprising of: linear waveguide, curved waveguide, circular waveguide, splitters, spiral waveguide, serpentine waveguide, branched waveguide, slab waveguide, parallel waveguide, converging waveguide, diverging waveguide, and interconnect waveguide.

[Claim 11] The waveguide of claim 1 wherein the patterned second layer defines at least one device.

[Claim 12] The waveguide of claim 1 wherein the substrate material comprises of at least one hard and non-flexible material from the group: silicon, glass, quartz, plastic, alumina, and ceramic.

[Claim 13] The waveguide of claim 1 wherein the substrate material comprises of at least one soft and flexible material from the group: plastic, polyimide, pyrex, and polymer.

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[Claim 14] A photonic waveguide comprising of:

a substrate,

a first layer of a nanomaterial,

a second layer of a nanomaterial,

a third layer of the first nanomaterial,

a fourth layer of an optical material,

wherein the second layer having the ability to amplify an optical signal,

wherein the second layer has a higher refractive index than the first layer,

wherein the third layer has the same refractive index as the first layer,

wherein the first layer is the bottom cladding,

wherein the third layer is the top cladding,

wherein the first and the third layers enclose the second layer, thus forming a waveguide,

wherein the second layer is an amplifying layer,

wherein the second layer is patterned to form the waveguide core, and pumped by a pump laser,

wherein the waveguide can amplify light at least in the wavelength range of 1060 to 1650 nm,

wherein the amplification wavelength range is tuned by choosing at least one rare-earth dopant species,

wherein the amplification efficiency is tuned at least by the concentration of the rare-earth metal ion incorporation in the second layer.

[Claim 15] The waveguide of claim 14 wherein the pump and the signal are combined via a coupler.

[Claim 16] The waveguide of claim 14 wherein the first layer is a dendrimer, spin-on-glass, nanosilica, polymer, and a composition thereof.

[Claim 17] The waveguide of claim 14 wherein the second layer is at least a dendrimer, a spin-on-glass, a nanosilica, a polymer, and a composition thereof.

[Claim 18] The waveguide of claim 14 wherein the second layer is incorporated with at least one rare-earth metal ion from a group comprising of: Erbium, Neodymium, Praseodymium, Thorium, Holmium, Terbium, Europium, and other rare-earth metal ions.

[Claim 19] The waveguide of claim 14 wherein the patterned second layer comprises of a plurality of waveguides.

[Claim 20] The waveguide of claim 14 wherein the second layer is comprised of at least one waveguide structure from a group of waveguide structures comprising of: linear waveguide, curved waveguide, circular waveguide, splitters, spiral waveguide, serpentine waveguide, branched waveguide, slab waveguide, parallel waveguide, converging waveguide, diverging waveguide, and interconnect waveguide.

[Claim 21] The waveguide of claim 14 wherein the patterned second layer defines at least one device.

[Claim 22] The waveguide of claim 14 wherein the substrate material comprises of at least one hard and non-flexible material from the group: silicon, glass, quartz, plastic, alumina and ceramic.

[Claim 23] The waveguide of claim 14 wherein the substrate material comprises of at least one soft and flexible material from the group: plastic, polyimide, pyrex, and polymer.

[Claim 24] A photonic waveguide comprising of:

a substrate,

a first layer of a nanomaterial,

a second layer of a nanomaterial,

a third layer of the first nanomaterial,

a fourth layer of an optical material,

wherein the second layer having the ability to modulate an optical signal via increased electro-optic coefficient,

wherein the second layer has a higher refractive index than the first layer,

wherein the third layer has the same refractive index as the first layer,

wherein the first layer is the bottom cladding,

wherein the third layer is the top cladding,

wherein the first and the third layers enclose the second layer, thus forming a waveguide,

wherein the second layer is patterned to form the core of the waveguide,

wherein the second layer is a modulating layer,

wherein the waveguide can modulate light at least in the wavelength range of 1060 to 1650 nm.

[Claim 25] The waveguide of claim 24 wherein the first layer is at least a dendrimer, a spin-on-glass, a nanosilica, a polymer, and a composition thereof.

[Claim 26] The waveguide of claim 24 wherein the second layer is at least a dendrimer, a spin-on-glass, a nanosilica, a polymer, and a composition thereof.

[Claim 27] The waveguide of claim 24 wherein the second layer is doped with at least one inorganic additive

[Claim 28] The waveguide of claim 24 wherein the second layer is doped with at least one organic additive such as a chromophore.

[Claim 29] The waveguide of claim 24 wherein the patterned second layer comprises of a plurality of waveguides.

[Claim 30] The waveguide of claim 24 wherein the second layer is comprised of at least one waveguide structure from a group of waveguide structures comprising of: linear waveguide, curved waveguide, circular

waveguide, splitters, spiral waveguide, serpentine waveguide, branched waveguide, slab waveguide, parallel waveguide, converging waveguide, diverging waveguide, and interconnect waveguide.

[Claim 31] The waveguide of claim 24 wherein the patterned second layer defines at least one device.

[Claim 32] The waveguide of claim 24 wherein the substrate material comprises of at least one hard and non-flexible material from the group: silicon, glass, quartz, plastic, alumina and ceramic.

[Claim 33] The waveguide of claim 24 wherein the substrate material comprises of at least one soft and flexible material from the group: plastic, polyimide, pyrex, and polymer.